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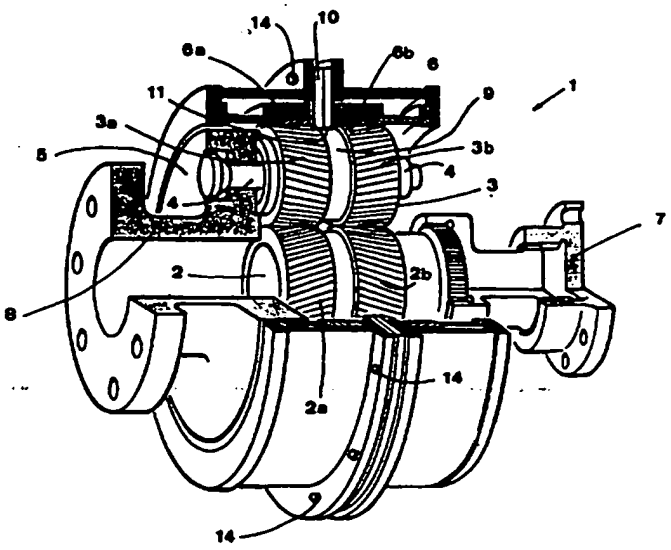

(57) Abstract

An epicyclic gear (1) comprises a sun wheel (2) having two tooth paths, at least three planet wheels (3), rotatably arranged in a planet carrier (5) and having two tooth paths, an outer ring wheel (6) with an inner gear ring having two tooth paths (6a, 6b), and a roller ring (10) which is arranged at the inside of the ring wheel between the two paths of the inner gear ring and provided with an inner cylindrical path against which the planet wheels are arranged to abut by means of a surface (9) which is provided between the tooth paths of the planet wheels. To permit the epicyclic gear (1) to absorb all transverse forces in an efficient way during all operational situations, the cylindrical inner path of the roller ring is constructed in such a way that it forms a continuous support path (11a, 11b) for the planet wheels, which path extends along the total inner periphery of the roller ring.

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An epicyclic gear and a roller ring

THE FIELD OF THE INVENTION AND PRIOR ART

The present invention relates to an epicyclic gear comprising a sun gear having two tooth paths, at least three planet wheels, rotatably arranged in a planet carrier and having two tooth paths, an outer ring wheel with an inner gear ring having two tooth paths and a roller ring which is arranged at the inside of the ring wheel between the two tooth paths of the inner gear ring and provided with an inner cylindrical path against which the planet wheels are arranged to abut by means of a surface arranged between the tooth paths of the planet wheels. The invention also relates to a roller ring for an epicyclical gear, comprising a ring which has an inner cylindrical path and a recess which is provided in said path.

Epicyclic gears comprise planet gears in which the ring wheel is stationary while the planet carrier and the sun wheel are rotating, sun gears in which the sun wheel is stationary while the planet carrier and the ring wheel are rotating, and star gears in which the planet carrier is stationary while the ring wheel and the sun wheel are rotating. Epicyclic gears may also be constructed such that both the sun wheel, the ring wheel and the planet carrier are arranged in order to rotate. In the most simple form of epicyclic gears each gear wheel only has one tooth path with straight teeth, that is teeth that extend in the direction of the longitudinal axis of the gear. Furthermore, epicyclic gears may comprise gear wheels with a tooth path with helical teeth. These result in a more silent operation than straight teeth and have the advantage that the gear still can be assembled in a relatively simple way. They also have the advantage, likewise to epicyclic gears with straight teeth, of permitting a certain axial movement of the sun wheel in relation to the planet wheels. Epicyclic gears with a tooth path with helical

teeth, however, give rise to forces of the same size but of opposite direction which act upon diametrically opposite teeth of each planet wheel. These forces result in a moment which tends to turn the planet wheel. Furthermore, epicyclic gears may comprise gear wheels each of which has two tooth paths that are parallel and provided axially beside each other with opposite directed helical teeth. Such an epicyclic gear has the disadvantage of making the assembly more complicated as the gear wheels cannot move in relation to each other in axial direction, and, accordingly, it is neither possible to assemble the gear only by pushing the gear wheels into each other, which in fact was possible with the types mentioned above. To solve this assembly problem the ring wheel is provided in two parts with one tooth path at each part. Accordingly, during the assembly the two parts of the ring wheel can be pushed in over the sun wheel and the planet wheels from a respective direction, and thereafter the parts are connected to each other by means of any suitable joint, for example a bolt joint.

By an epicyclic gear it is well known to mount a roller ring inside the ring wheel, for example between the two inner wheel paths. The roller ring has a circular inner roller path against which the planet wheels take support by rolling and to a certain extent gliding upon this path. Such a roller ring has as its task to absorb the existing transverse forces while the moment forces are absorbed by the teeth. It contributes to reduce the risk for dynamic instability and vibrations. Particularly, by the sorts of epicyclic gears where the ring wheel is rotating, such a roller ring is of essential importance.

However, such a roller ring makes the assembly of the epicyclic gear more difficult because the roller ring, which bears on a groove between the two tooth paths of the planet wheels, due to that, can not be positioned upon the set of planet wheels and the sun wheel. To solve this problem it has been proposed to provide the roller ring with a recess in the inner cylindrical path. This recess must be of such size that the planet wheels one at a time can be positioned between the roller ring and the sun wheel. Due to this recess the planet wheels, however, have no full support in all rotational

positions of the gear. This creates problems, particularly by the variants of epicyclic gears where the ring wheel with the roller ring and the inner tooth paths is rotating, because, in this case, the roller ring bears the weight of the rotating ring wheel.

SUMMARY OF THE INVENTION

Accordingly, the object of the present invention is to provide an epicyclic gear which has a roller ring which in an effective way has the ability of absorbing all transverse forces in all operational situations.

This object is obtained by the epicyclic gear initially defined, which is characterized in that the cylindrical inner path is designed such that it forms a continuous support path for the planet wheels, which path extends along the total inner periphery of the roller ring. By such a design of the roller ring the planet wheels will always be in contact with the inner cylindrical path of the roller ring, and, therefore, the roller ring will absorb all transverse forces in every operational moment. In that way, a stable and vibrational free rotation of the gear is obtained.

According to a first embodiment the roller ring has at least one recess in the cylindrical path, and closing means which are arranged to be brought between an open mounting position that releases the recess and makes it possible to insert the planet wheels between the sun wheel and ring wheel, and a closed operational position which closes the recess and makes it possible to recreate the inner cylindrical path in such a way that it extends along the total inner periphery of the roller ring. By such a design of the roller ring a continuous support path for the planet wheel is obtained during operation at the same time as the gear is mountable in a simple way, because the planet wheels can be inserted through the recess one at a time between the sun wheel and the roller ring.

Advantageously, the closing means comprise a portion which has an inner path with the same radius of curvature as the inner cylindrical

path of the roller ring and is arranged beside the roller ring and is displaceable between a closed position in which the portion extends over the recess, and an open position in which the path of the portion is located beside the recess. According to a particularly simple and advantageous embodiment, the closing means comprise a further roller ring. Furthermore, the further roller ring may comprise a recess and be arranged axially beside the roller ring, the roller rings being rotatable in relation to each other between an open position in which the recesses are in alignment, and a closed position in which the recesses are displaced in relation to each other in the peripheral direction. Furthermore, the roller rings may be fixed to each other by means of a fixing member which, in a released position, permits a relative motion in the peripheral direction of the roller rings.

According to a second embodiment the sun wheel comprises two parts that are releasably connected to each other, and each part bears one of the two tooth paths of the sun wheel. Such an embodiment permits the assembly of the gear by provision of the planet wheel in place inside the ring wheel and the roller ring mounted therein, whereafter the two parts of the sun wheel are inserted between the planet wheels from a respective direction. Preferably, the two parts of the sun wheel are connected to each other by means of a bolt joint which extends in axial direction through the two parts.

According to a third embodiment each planet wheel comprises two parts which are releasably connected to each other, and each part bears one of the two tooth paths of the planet wheels. By this embodiment the assembly of the gear is made possible by holding the ring wheel with the roller ring mounted therein and the sun wheel in place and inserting the two parts of the planet wheels between the sun wheel and the ring wheel from a respective direction. Preferably, the two parts of each planet wheel are connected to each other by means of bolt joints extending in axial direction through both the parts.

The inventive gear may be a star gear, a sun gear or a planet gear. It may also constitute an epicyclic gear in which the sun wheel, the ring wheel and the planet carrier are arranged to rotate.

The object of the invention is also obtained by the initially defined roller ring, which is characterized in that the roller ring comprises a second ring and that the rings are rotatable in relation to each other between an open position in which the recess is exposed, and a closed position in which the recess is closed. Preferably, the second ring comprises a recess which is arranged such that the recesses are in alignment during the open position and that they are displaced in relation to each other during the closed position.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be explained more in detail by means of different embodiments which are shown on the accompanying drawings.

Fig 1 shows an epicyclic gear according to a first embodiment of the invention.

Fig 2 shows a roller ring for the gear shown in Fig 1.

Fig 3 shows an epicyclic gear according to a second embodiment of the invention.

Fig 4 shows an epicyclic gear according to a third embodiment of the invention.

DETAILED DESCRIPTION OF DIFFERENT EMBODIMENTS

In Figs 1, 3 and 4 an epicyclic gear 1 is shown. The gear 1 comprises a central sun wheel 2 with two tooth paths 2a and 2b. A plurality of planet wheels 3 with the corresponding tooth paths 3a and 3b are arranged around the sun wheel 2. The planet wheels 3 are supported by a spindle 4 which is provided in a planet carrier 5. The planet gear 1 comprises at least three planet wheels 3, but there may also be more such ones arranged around the total periphery of the sun wheel 2. A ring wheel 6 is provided around the planet wheels 3, said ring wheel having an inner gear ring with two

corresponding tooth paths 6a and 6b. As can be seen in Figs 1, 3 and 4 the gear 1 has an outgoing shaft 7 which is fixedly connected to the sun wheel 2 and an outgoing shaft 8 which is fixedly connected to the planet carrier 5. The inventive gear 1 may, however, also comprise an outgoing shaft which is connected to the ring wheel 6. Accordingly, the present invention can be applied in different combinations. For example, the planet carrier 5 may be fixedly arranged, the outgoing shaft which is fixedly connected to the ring wheel 6 for instance being connected to a generator, and the shaft 7 which is fixedly connected to the sun wheel 2 being connected to a turbine shaft. In such an application the epicyclic gear 1 is called a star gear. However, the gear 1 may also be constructed as a sun gear, the sun wheel 2 being fixedly arranged while the outgoing shaft 8 of the planet carrier 5 and the outgoing shaft of the ring wheel 6 rotate. Furthermore, the gear 1 may be constructed in such a way that all outgoing shafts are arranged to rotate. Finally, the shaft 1 may also be constructed as a planet gear, the ring wheel 6 being fixedly arranged while the outgoing shaft 8 of the planet carrier 5 and the outgoing shaft 7 of the sun wheel 2 rotate.

Between the tooth paths 3a and 3b of the planet wheels 3 there is a groove 9 which extends fully around the planet wheels 3 in the peripheral direction thereof. The grooves 9 have a precision-machined bottom surface. Between the tooth paths 6a and 6b of the ring wheel 6 a roller ring 10 is arranged. The roller ring 10 has an inner cylindrical path 11 which extends around the inner periphery of the roller ring 10. The planet wheels 3 are arranged to bear on the inner cylindrical path 11 of the roller ring 10 by means of the bottom surface of the grooves 9. Thereby, the planet wheels 3 will rotate on the inner path 11 in approximately the same way as the balls are rotating in a ball bearing, that is the planet wheels 3 are moving in relation to the roller ring 10 by a combined rolling and, to a certain extent, gliding motion.

The roller ring 10 shown in Figs 1 and 2 is comprised by two rings 10a and 10b arranged axially beside each other. Each one of these

rings has an inner cylindrical path 11a and 11b and a recess 12a and 12b in these inner cylindrical paths 11a and 11b. The rings 10a and 10b are concentric and may be rotated in relation to each other in such a way that both the recesses 12a and 12b will be in alignment, opposite to each other. This position is called the mounting position, and in this position it is possible to assemble the gear 1 by lowering the roller ring 10 downwards over the sun wheel 2 and a planet wheel 3. Thereafter, a further planet wheel 3 may be inserted between the roller ring 10 and the sun wheel 2 through the two aligned recesses 12a and 12b. Subsequently, this second planet wheel 3 is rolled aside and a further planet wheel 3 can be inserted between the sun wheel 2 and the aligned recesses 12a and 12b. In that way a required number of planet wheels 3 can be arranged, and when this has been done the two rings 10a and 10b of the roller ring 10 are rotated in relation to each other in such a way that the recesses become displaced in relation to each other, for example by 180°. In that way the planet wheels cannot any longer be removed from the gear 1 and the inner cylindrical paths 11a and 11b of the rings 10a and 10b form a continuous surface which extends around the total inner periphery of the roller ring 10. Thereafter, the planet wheels 3 with their spindles 4 are mounted in the planet carrier 5 and the two tooth paths 6a and 6b of the ring wheel 6 are positioned over the planet wheels 3. Each ring 10a and 10b has axially directed openings 13 which define the position that closes the recesses as they are located opposite to each other. By means of for instance a bolt joint 14 which extends through holes in flanges of the tooth paths 6a and 6b of the ring wheel 6 and through the holes 13 the two tooth paths 6a and 6b of the ring wheel 6 are locked in the required position together with the two rings 10a and 10b of the roller ring 10, which are located between said paths.

In the embodiment shown in Fig 3 the gear 1 comprises a sun wheel 2 which is divided in two parts 16 and 17 along the line 15. The parts 16 and 17 are kept together by means of a joint, for example by means of the screw joints 18 suggested in Fig 3. By this embodiment the epicyclic gear 1 is assembled by putting the roller ring 10 and the two tooth paths 6a and 6b of the ring wheel 6

together, whereafter the planet wheels 3 are put in place and into engagement with the tooth paths 6a and 6b of the ring wheel 6. Thereafter, the two parts 16 and 17 of the sun wheel 2 are inserted from a respective direction and are subsequently screwed together by means of the screw joints 18. In this second embodiment the roller ring 10 accordingly is in one piece and has no recess at the inner cylindrical path 11.

In the embodiment shown in Fig 4 the planet wheels 3 instead comprise two separate parts 20 and 21 along the line 19. Also by this embodiment the two parts 20 and 21 of the planet wheels 3 are held together by some kind of joint, for example a screw joint 22. In this case the epicyclic gear 1 is mounted by holding the ring wheel 6, which is connected to the roller ring 10, and the sun wheel 2 in a correct position, whereafter the two parts 20 and 21 of the planet wheels 3 are inserted from a respective direction and are connected to each other by means of the screw joints 22. Also in this third embodiment the roller ring 10 is thus in one piece and does not have any recess at the inner cylindrical path 11.

Claims

1. An epicyclic gear (1) comprising a sun gear (2) having two tooth paths (2a, 2b), at least three planet wheels (3), rotatably arranged in a planet carrier (5) and having two tooth paths (3a, 3b), an outer ring wheel (6) with an inner gear ring having two tooth paths (6a, 6b) and a roller ring (10) which is arranged at the inside of the ring wheel (6) between the two tooth paths (6a, 6b) of the inner gear ring and provided with an inner cylindrical path against which the planet wheels (3) are arranged to abut by means of a surface (9) arranged between the tooth paths (3a, 3b) of the planet wheels, characterized in that the cylindrical inner path (11a, 11b) is designed in such a way that it forms a continuous support path for the planet wheels (3), which path extends along the total inner periphery of the roller ring (10).

2. An epicyclic gear according to claim 1, characterized in that the roller ring (10, 10a) has at least one recess (12a) in the cylindrical path (11a) and closing means (10b) which are arranged to be displaced between an open mounting position that releases the recess (12a) and makes it possible to insert the planet wheels (3) between the sun wheel (2) and the ring wheel (6), and a closed operational position that closes the recess (12a) and makes it possible to recreate the inner cylindrical path (11) such that it extends along the total inner periphery of the roller ring (10).

3. An epicyclic gear according to claim 2, characterized in that the closing means (10b) comprises a portion which has an inner path (11b) with the same radius of curvature as the inner cylindrical path (11a) of the roller ring and is arranged beside the roller ring (10a) and displaceable between a closed position where the portion (10b) extends over the recess (12a) and an open position where the path (11b) of the portion (10b) is located beside the recess (12a).

4. An epicyclic gear according to claim 2 or 3, characterized in that the closing means comprises a further roller ring (10b).

5. An epicyclic gear according to claim 4, characterized in that the further roller ring (10b) comprises a recess (12b).

6. An epicyclic gear according to claim 5, characterized in that the further roller ring (10b) is provided axially beside the roller ring (10a) and that the roller rings (10a, 10b) are rotatable in relation to each other between an open position, in which the recesses (12a, 12b) are in alignment, to each other, and a closed position, in which the recesses (12a, 12b) are displaced in relation to each other in the peripheral direction.

7. An epicyclic gear according to claim 6, characterized in that the roller rings (10a, 10b) are fixed to each other by means of a fixing member (14) which, in a released position, permits a relative movement in the peripheral direction of the roller rings.

8. An epicyclic gear according to claim 1, characterized in that the sun gear (2) comprises two parts (16, 19) that are releasably connected to each other and that each part bears one of the tooth paths (2a, 2b) of the sun wheel.

9. An epicyclic gear according to claim 8, characterized in that the two parts (16, 17) of the sun wheel (2) are connected to each other by means of bolt joints (18) that extend in axial direction through the two parts.

10. An epicyclic gear according to claim 1, characterized in that each planet wheel (3) comprises two parts (20, 21) that are releasably connected to each other and that each part bears one of the two tooth paths (3a, 3b) of the planet wheels (3).

11. An epicyclic gear according to claim 10, characterized in that the two parts (20, 21) of each planet wheel are connected to each other by means of bolt joints (22) that extend in axial direction through the two parts (20, 21).

12. An epicyclic gear according to any of the preceding claims, characterized in that the teeth of the tooth paths (2a, 2b; 3a, 3b; 6a, 6b) are inclined.

13. An epicyclic gear according to any of the preceding claims, characterized in that the epicyclic gear (1) is comprised by a star gear in which the planet carrier (5) is stationary while the ring wheel (6) and the sun wheel (2) rotate.

14. An epicyclic gear according to any of the claims 1 to 12, characterized in that the sun wheel (2), the ring wheel (6) and the planet carrier (5) are arranged to rotate.

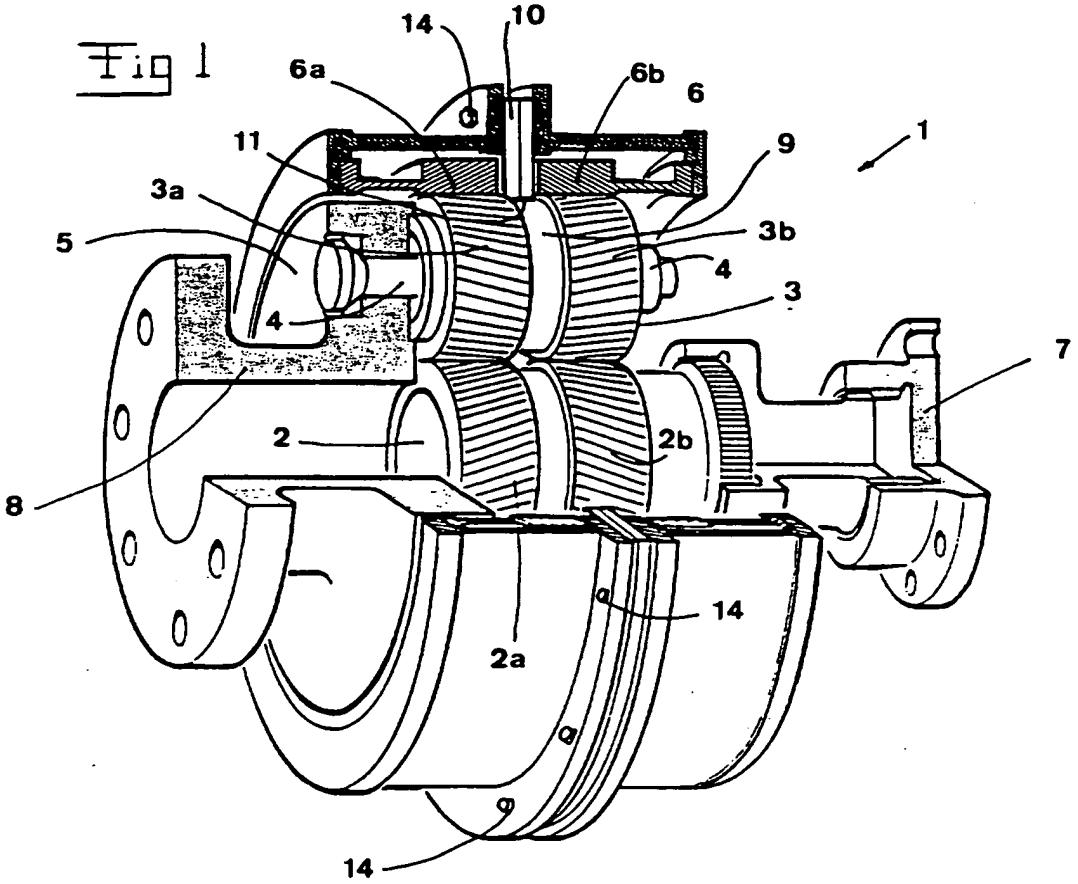
15. An epicyclic gear according to any of the claims 1 to 12, characterized in that the epicyclic gear (1) is comprised by a sun gear in which the sun wheel (2) is stationary while the planet carrier (5) and the ring wheel (6) are rotating.

16. An epicyclic gear according to any of the claims 1 to 12, characterized in that the epicyclic gear (1) is comprised by a planet gear in which the ring wheel (6) is stationary while the planet carrier (5) and the sun wheel (2) are rotating.

17. A roller ring (10) for an epicyclic gear, comprising a first ring (10a) having an inner cylindrical path (11a), and a recess (12a), provided in said path, characterized in that the roller ring comprises a second ring (10b) and that the rings (10a, 10b) are rotatable in relation to each other between an open position, in which the recess (12a) is exposed, and a closed position, in which the recess (12b) is closed.

18. A roller ring according to claim 17, characterized in that the second ring (10b) comprises a recess (12b) which is arranged such that the recesses (12a, 12b) are aligned during the open position and are displaced in relation to each other during the closed position.

Fig 1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10
6a
6b
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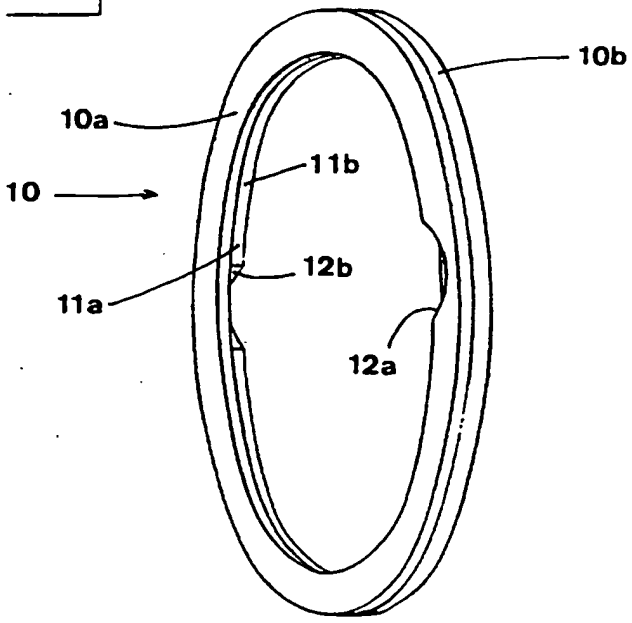
2a
14

Fig 2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10a
11b
10
12b
11a
12a

Fig 3

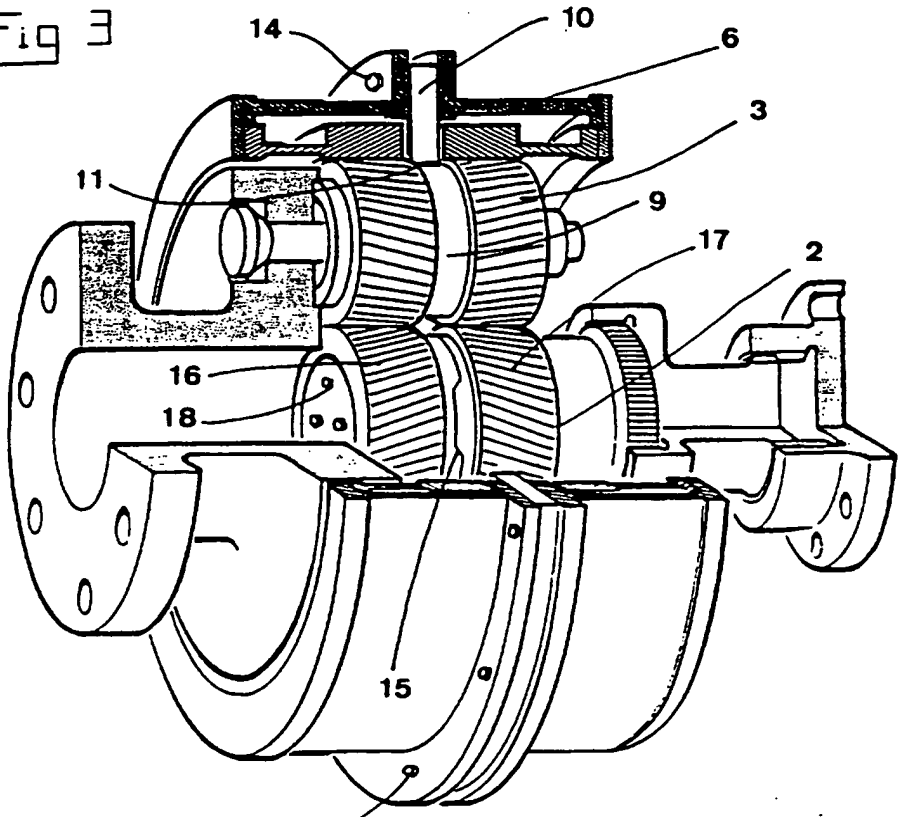
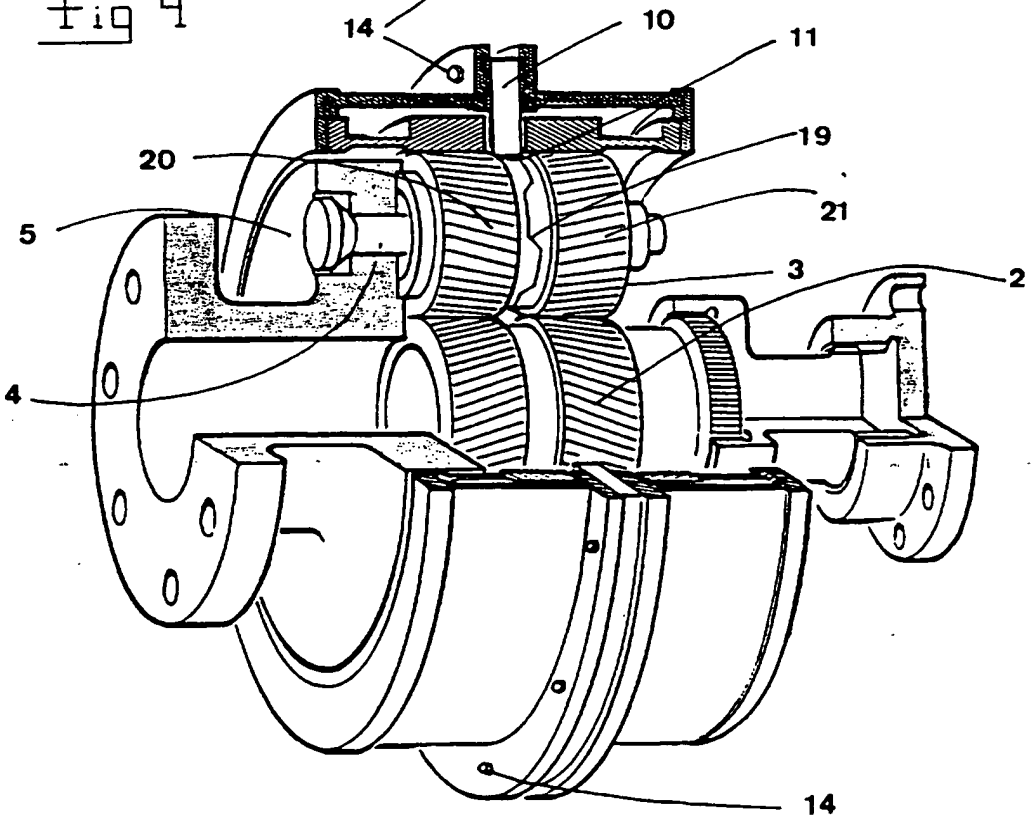


Fig 4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 96/01482

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F16H 1/28
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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: F16H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

Information on patent family members

28/10/96

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